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(54) **Electronic locking device.**

(57) An unlocking device having a circuit (22) to judge if the voltage of the ordinary power source (11,15) circuit incorporated in a device to operate an electric driver (13) is maintained at a specified level. When the voltage of the said ordinary power source (11,15) circuit is not maintained at the specified level, the said electric driver (13) is conducted for unlocking by an external power source (28) through the circuit (23) having the connection terminals to the said external power source (28).

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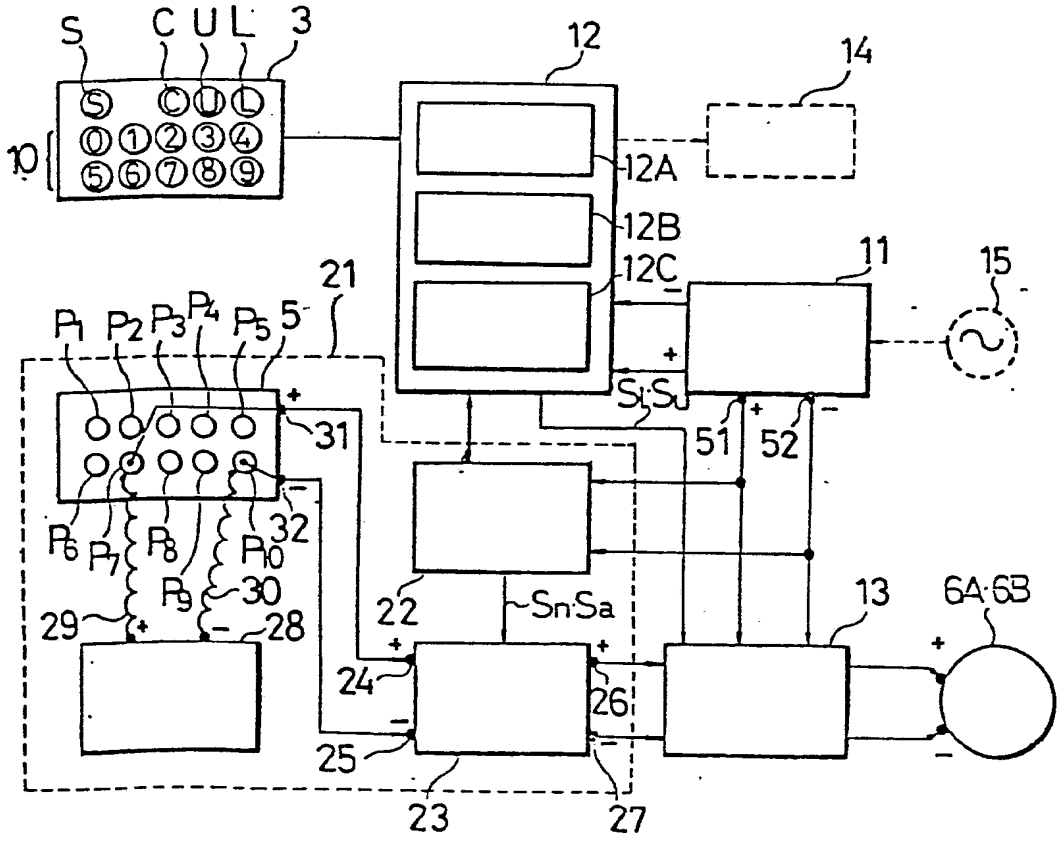
FIG. 2
第 2 図


S
C
U
L
3
10
12
14
12A
12B
12C
11
15
21
P1
P2
P3
P4
P5
5
31
32
P6
P7
P8
P9
P10
30
29
28
22
Sn
Sa
13
6A
6B
24
26
25
23
27
51
52
S1
S2

1

TITLE OF THE INVENTION

ELECTRONIC LOCKING DEVICE

DETAILED DESCRIPTION OF THE INVENTION

This invention relates to an electronic locking device for locking or unlocking by memory and relational computing process of the code information given by key input of external memory code.

Compared with mechanical locks to insert a key for locking and unlocking used so far for buidling doors and others, electronic locks are free from such worries as to carry the key at all time, missing of the key, or possible burglary by duplicated key, and are now used for many purposes other than building doors such as safes, automobile doors or suit cases. Though a number of different contrivances may have been made to these electronic locking devices, all of these devices are basically composed of a key button operation unit for input of external memory codes, a memory to memorize the input codes, a control circuit for relational computing of the input, a control unit for locking and unlocking such as a micro-computer or sequencer. The differences in these devices are in the contrivance for complete secret keeping of the code, i.e. the one composed to be renewed at any time freely by a specific person or the one composed to be renewed within a limited time only. Almost all of electronic locks

composed in such a manner are free from the defects of mechanical locks as described above and their confidential preservation of code is higher than that by numerical unlocking of dial type locks. They are primarily composed of electronic circuits, however, they all have problems such as voltage reduction of the battery incorporated as the power source for each circuit or as the driving power for solenoid or motor, failure of the rectifier to convert commercial power into the source voltage of the locking device, and consumption or troubles in the power source system like power failure in the commercial power source which fails to operate the above circuit, solenoid or motor resulting in the prevention of unlocking. Another disadvantage is that the unlocking of doors or suit cases becomes also impossible when the battery voltage as the power source of the micro-computer is consumed or in trouble, the memory is cancelled by some trouble in the circuit composed of a number of electronic parts or when any other function of the computer fails while the door or suit case is being locked because the solenoid or motor is not operated by regular key input.

In view of the foregoing, it is a general object of this invention to solve the problems by conventional electronic locking devices in that the unlocking becomes impossible at voltage reduction or trouble in the power source system or by a defective electronic part of the

micro-computer, and to offer a device having means to detect any trouble in the said power source system or the said micro-computer system, to enable unlocking with simple operation by the detected signal,by an external power source or by an incorporated battery immediately before renewal, and yet to keep the abnomal unlocking operation highly confidential.

Another object of the invention is to offer a device that makes unlocking operation more confidential simply.

A further object of the invention is to offer a device that unlocking can be made simply and quickly with confidence when the micro-computer control unit fails to function only if the driving power for the solenoid or motor is normal, and should the driving power source is in trouble in addition, unlocking can be also with an readily available external power source.

A still further object of the invention is to offer a device that enables easy unlocking by utilizing an external power source when the incorporated power system or computer is out of order so as to make it easy to handle in case the code is foregotten, although the performance for confidental preservation becomes somewhat lower.

Referring now to the drawings, the present invention is described in further detail from the first embodiment and on. Fig. 1 is a large sized suit case mounted with

an electronic locking device of the present invention and the casing 1 is made of duralumin and the electronic locking device 2 is attached to the center of the casing. A key button control board 3 is placed several mm below the panel surface of the locking device 2 on which ten number keys and four function keys are provided. The receptacle of 10 core connector 5 is provided close to the clasp(4B) of the casing 1, which functions as the external power source terminal for abnormal unlocking and is normally closed by a cover that can be mounted or dismounted freely, though it is not illustrated. The magnetic solenoids 6A, 6B shown by dotted lines are attached to the inside of the casing 1 and used as the control terminal to lock or unlock the clasps 4A, 4B by key input (code numbers) into the electronic locking device. The control unit 12 of the micro computer for operation process of the said key input is provided on the lower face of the key button control board 3 as shown by the dotted line, and the power source, DC6V mercury lamp for instance, is attached to the same place so as to be replaced.

Fig. 2 is the block diagram showing the circuit composition of an electronic locking device by this invention. Of the 14 key buttons on the control board 3, power switch (S) is to be turned on for locking or unlocking when the incorporated ordinary power source 11 is normal, key (C) is the clear key to cancel the number keys 10 from the memory when the code number is

set incorrectly, and key (L) is the lock key to operated the solenoid 6 for locking after setting a code number correctly by the number keys 10. After locking, the power is turned off by the said key (S). Key (U) is the unlocking key to be pushed to operate the solenoid 6 for unlocking to open up the suit case after turning on the power by the said key (S) and then setting the said code number by the number keys 10. The control unit 12 functions to memorize a specific code number from the control board 3 into the memory circuit 12A to compare the memorized number in the comparison circuit 12B with the number set on the control board 3 at locking or unlocking, and to give the output of lock signal (Sℓ) or unlock signal (Su) from the control circuit 12C to the driving circuit 13 only when the compared numbers are in agreement. Though it is not provided in the embodiment of Fig. 1, the block shown by dotted line 14 is an indicator, which is to provide close to the control board 3 and indicates the code number set by crystalline liquid letters. The dotted line 15 is the commercial power source used for building doors and others, the incorporated ordinary power unit 11 is used for commutation and also as a constance voltage equipment. In the embodiment of Fig. 1, this incorporated ordinary power unit 11 is a mercury battery of DC6V, as described above, and also functions as the power for the control unit 12 as well. One of the key point of the present

invention is the part enclosed by the dotted frame 21 in Fig. 2, in which the receptacle of 10 core connector 5 has the socket connetors P1 to P10, which are can also be pins. The voltage of the ordinary power unit 11 is normally applied to the judging circuit of voltage 22, and when the foltage level is over DC5V, at which the solenoids 6A, 6B function normally, the signal (Sn) of normal voltage is given to the power switching circuit 23, and when it is below DC5V (including OV), the signal (Sa) of abnormal voltage is supplied. The power switching circuit 23 is so composed that no output is made at the output terminals 26, 27 however voltage is applied to the input terminals 24, 25 through the external terminal 5 so long as the said input signal is (Sn) i.e. the power source 11 maintains the voltage above the specified level. If the life of the mercury battery 11 is expired (or if the commutation equipment is in trouble) and the device does not function normally, a readily available power such as automobile battery (DC12V), for instance, is used as the external power source 28, or the clasp 4A of Fig. 1 as the positive (+) side of the external power source terminal and the crasp 4B as the negative (-) side of the terminal are directly connected with the lead wires 29, 30 (not illustrated), and when DC12V is applied to the input terminals 24, 25, the switching circuit 23 gives the output of the above DC12V to 26, 27 and operates the

solenoides 6A, 6B through the operation terminal driving circuit 13 making it possible to unlock because the input signal from the voltage judgement circuit 22 is (Sa) as described above. Then the suit case can be opened by the manual locking device of the clasps 4A, 4B.

The above method to use the clasps directly as the external power source terminals is simple and accordingly the cost is lower, but has a disadvantage in keeping abnormal unlocking operation confidential. That is, the unlocking method will also become known widely as the suit cases of this type become popular. Accordingly, multi-core connector of higher secret retaining performance is used as an embodiment of the present invention.

As shown in Fig. 2 the 10 core socket connctors P7 and P10, which are selected and at random out, are connected as (+) and (-) terminals respectively, then the code of (+)=P7 and (-)=P10 is made know only to the owner of the suit case. If someone else who are not allowed to open the suit case of this composition tries to open it by inserting (+) and (-) terminals of DC12V into the 10 core connector at random, the probability to fit the said code is $1/\{(n-1) + (n-2)..... ...+1\} \times 2 = 1/90$, where (n) is the number of cores of the connector, and practically, this is safe enough. If a connector of more number of cores is used, it will

become almost impossible to open the suit case by any other person who does not know the code number.

The structure and the function of the unlocking device according to this invention at a trouble of the power source are as described above, and now follows the description along Fig. 3 of an embodiment of the voltage judging circuit 22 and power source switching curcuit 23 of Fig. 2. Of course the description is made only by way of example and not as a limitation on the scope of the invention.

In Fig. 3, terminals 51, 52 are respectively (+) and (-) of the ordinary power source 11, and each one of the NPN transistor of emitter earthing type 53, 54, 55, in which the transisitor 55 has a large current amplification factor (β). A zener diode of 3V break-down voltage 56, diodes 57,58, the resistor 60 and the condenser 61 are provided in the voltage judging circuit 22 and power source switching circuit. In this composition, the said output signals (Sℓ) (Su) from the control unit (12) are applied to the base of the transistor (53) as the driving circuit (13) and also the battery voltage of the power source 11 is over the specified level of DC5V, the transistor 54 is conducted by the constant voltage function of the zener diode 56, the emitter current (I_1) flows, no base current flows to the base 55B of the transistor 55 even if DC12V is applied, and the transistor 55 is turned off ($I_2 = 0$).

Because of this action, the solenoid 6 is driven only by the signals (Sℓ), (Su). The above are the operations under normal condition. Now if the voltage of the power source 11 comes down below the specified level of DC5V, the signals from the control unit 12 stop and the transistor 53 is turned off. The zener diode 56 is also turned off at the same time and the transistor 54 is turned to non-conducting (I_1=0). After that, the external power source voltage of DC12V is applied to the terminals 31, 32, the voltage is turned into unlocking voltage of DC6V by the diode 57 and resister 59, and the zener diode 56 is turned on again. The base voltage 54B of the transistor 54 is applied being delayed by the time (TL) determined by the time constant elements 60, 61, 0.3 sec. for instance. On the other hand, the transistor 55 is turned to on (I_2 is generated) since the base current flows through the base 55B as soon as the above DC12V is applied, and the unlocking voltage of DC6V is applied to the solenoid 6 for abnormal unlocking operation and is turned off after the above mentioned 0.3 sec.

Described above is the first embodiment of the electronic locking device according to this invention. When the locking device is used for building doors or safes, a lamp or buzzer may sometimes be provided on the control board. Many other compositions are also conceivable.

Now referring to Fig. 4, which is the block diagram

4.5V for stable use of the battery voltage and intending for earlier replacement of the battery as mentioned above. The locking preventive drive circuit 44 is operated by this signal (SA), and the voltage (VA) slightly lower than the specified DC4.5V, 4.4V for instance, is supplied to the auxiliary solenoid 45 and also to the main solenoid 6M. Unlike the main solenoid 6M, the setting of the operation level for the auxiliary solenoid 45 is at 4.5V (minimum operation level 3.4V), and by the input of this voltage (VA), the automatic unlocking and locking preventive mechanism 46 is operated through the action A1 shown by continuous line. At the same time, the main solenoid 6M applies the operation of the action A2 to the normal locking mechanism 43 by above voltage (VA), i.e. 4.4V, for mechanical coupling A3 with the said mechanism 46. If the normal locking mechanism 43 is at locked condition, the mechanism is unlocked, and if it is at non-locked condition, it does not react to the input of locking signal (SL) given by key input through the driving circuit 13, and the mechanism is kept being unlocked.

Of the control unit 6, further description is given below on blocks 6M, 43 shown in Fig. 5, which is the cross sectional drawing of the control unit 6 of the clasp 4A for the suit case shown in Fig. 1 incorporated the said mechanisms 43, 46 into an unit. The member 72 of ⊓-shape connected to the knob 7 with the rivet 71

so as to slide freely in arrow direction (a) and (b) forms the lock shaft, and the locking unit 72T at the top of the lock shaft is inserted into the latch 8F of the said hook 8. The fixed cover 73 is screwed onto the said clasp latch 4A on which the guide holes for the top ends 72AT, 72BT of the sides 72A, 72B of the lock shaft 72 are provided to control the above movements in (a) and (b) direction. A scissors-shaped compression spring 73 having one end as the fulcrum point (not shown) keeps pushing the lock shaft in the direction (b) at all times. A locking plate 75 for locking by key input when the lock shaft 72 is at the position of this drawing, i.e. the hook 8 is locked. The locking plate 75 has a lock hole 75H and is connected and fixed to the lock shaft 72. The top end of the movable piece 76 of the main solenoid 6M described in Fig. 4 is inserted into the lock hole 75H, and it moves up and down with the shaft 77 supported by the bearing on the cover 73 as the fulcrum point by the drawing force of the solenoid 6M and by the pulling force of the tension spring 78. At the key input of the code number into the control board 3, the solenoid 6M functions to draw the movable piece 76 and the top 76T1 of the movable piece 76 goes out of the lock hole 75H. When the knob 7 is pushed in the direction (a), therefore, the hook 8 is sprung up to the position 8', and the suit case can be opened.

Referring to Fig. 5 and Fig. 6, an auxiliary solenoid 4 5 mounted on the solenoid fixing plate 80. The movable

piece 92 is connected to the tension spring 94 and the balance weight 95 with the shaft 93 supported by the bearing provided on the fixing cover as the fulcrum point. It is drawn to the solenoid when a voltage slightly lower than the specified voltage, (VA) in Fig. 4 is applied. Fig. 6 shows an oblique view of the mechanism of Fig. 5 excluding the said solenoids 6A, 45 from the bottom side, and the top end 92T of the said movable piece 92 is inserted into the latch hole 96H on the latch plate 96. The bent parts 96A at both sides of the latch plate 96 are inserted into the two grooves 73S on the fixing cover 73, and the top ends of the bent part 96AT are bent further. Accordingly, the latch plate 96 is supported by the fixing cover so as to move freely along the said grooves 73S. In addition, the bent part 96P at the left end of the latch plate 96 shown in Fig. 5 is always pushed in the arrow direction of Fig. 6 by the spring force (F) at the free end 99T of the scissors-shaped compression spring 99 which is connected to the pin 97 and the knock 98 on the fixing cover. The square notch 96K at the right end of the latch plate 96 is wider than the top end width 96T1 of the said movable piece 76 and is narrower than the root width 76T2.

Because of the above composition, the main solenoid 6M functions when the battery voltage drops and the auxiliary solenoid 45 is operated by the voltage (VA),

the movable piece 76 is drawn upward of Fig. 6, the movable piece 92 of the said auxiliary solenoid 45 is also drawn upward at the same time, and the latch plate 96 released from the top end 92T is pushed out by the spring force (F) of the spring 99 inserting the top end 76T1 of the said movable plate 76 into the notch 96K. This operation is the coupling A3 of Fig. 4. By this operation, the locking of the lock shaft 72 in Fig. 5 is released, thus the suit case can be opened by pushing the unlocking knob 7 into the arrow direction (a) with a finger. After this, the main solenoid 6M can never be operated by any key input if the power source 19 of the control unit is normal and so long as the power source 11, i.e. DC6V battery is not replaced with a new battery. Accordingly, the movable piece 92 is kept being caught by the latch plate 96 and the lock shaft 72 can not be locked. Even if the power to both solenoids is cut off, the mechanical coupling between the latch plate 96 and the movable piece 76 is not disengaged and the locked condition is maintained. When the knob is pushed in the direction (b) after replacing the battery, the left end bent part 72C of the lock shaft in Fig. 5 pushes back the bent part of the latch plate 99P against the spring force of the spring 99 and the original condition of Fig. 6 is restored.

Now, referring to Fig. 7, embodiments of concrete circuits of the blocks of voltage judging circuit 42,

change-over circuit 43 and driving circuit 44 in Fig. 4 are described as follows. When the battery voltage 11 is over the specified value, i.e. between 4.5 V to 6V, the Zenor diode 104 is turned on and the transistor 103 is conducted, and therefore, the emitter current I1 flows through the resistor 107 and the base current does not flow the base 102b of the transistor 102. Accordingly, the transistor 102 is turned off and the auxiliary solenoid 45 does not function, but the main solenoid 6M is operated by the emitter current Io of the transistor 101 which is turned on and off by the output signals SL, Su from the control unit12. This is the operation at normal voltage condition, and when the battery is consumed and the voltage drops below 4.5V, the Zener diode 104 is turned off and the transistor 103 is then turned to OFF. This is the operation of the voltage judging circuit 42 in Fig. 4, and by this operation, the transistor 102 is conducted to generate the current I2 through the auxiliary solenoid 45. At the same time, the operating current (I_3) also flows through the diode 105 since the main solenoid 6M is operated at 3.8V and over as explained previously. Once operated by the current I3, the main solenoid keeps the operating condition with no regard to the signals SL, Su. It makes no difference, therefore, whether or not the power source 19 of the control unit 12 is provided separately.

As for the driving power source for the solenoid or

motor in these embodiments, a battery is used. This composition, however, is also applicable to other cases where commercial power source is used by commutation to building doors, for example, and when the voltage goes down below the specified level due to a trouble of the component part, except for such troubles as power failure or zero voltage. That is, the same operation is made when the voltage drops down to the minimum operating voltage of the main solenoid or the motor. The mechanism and circuit composition are not limited to those illustrated in Fig. 5, Fig. 6 and Fig. 7, and many others are also conceivable, all of which are of course within the scope of this invention.

Now the description is made on the 3rd embodiment i.e. the device so composed to accept unlocking at the abnormal condition of the control unit to memorize key input from outside and to process code information by relational computation. In other words, at a trouble in the power source system of the micro-computer or in any one of the circuit parts. For the device of this embodiment, there is no need to provide any special micro-coumputer that has the unlocking function at abnormal condition, but the clock pulse of square wave always generated by ordinary micro-computers for the timing control is used. Troubles in the micro-computer or in the power source is immediately detected by the suspension of the said clock pulse, and abnormal control

signal output is given by a simple electronis circuit composition.

How back to Fig. 1 to explain the parts provided specially for this embodiment, the small holes 9A, 9B at the upper center of the clasps 4A, 4E are the external power source connecting terminals for abnormal unlocking when the ordinary power source to drive the solenoid of DC6V is out of order. As the external power source, DC12V is taken out of an automobile battery, for example, with lead wires, and the positive (+) side is passed through the small hole 9A of the clasp 4A and the negative (-) side through the small hole 9B of the clasp 4B. The positions of the small holes 9A, 9B are not necessarily be at the points as illustrated and the lead wires may also be connected to the metal parts of the clasps using alligator clips without providing any small hole.

Fig. 8 is the block diagram to show the circuit configuration of the elctronic locking device by this invention. One of the key point of this invention is the block double enclosed by continuous line and dotted line in Fig. 8 and the signal system. The clock pulse generating circuit 12P is generally provided for the timing control of the control unit 12. During the operation of the control unit 12, which is by the power source 19 and is composed of CMOS (Complementary Metal-Oxide Semiconductor), the clock pulse of pulse width (T_D=74 msec) and pulse recruuence frequency (Tp = 120 msec) in this embodiment, is generated at all times.

The pulse system in the control unit 12 is omitted. The detection circuit 111 of the suspension of the said clock pulse (Pc) is one of the key points of this invention. Though the detailed circuit compostion of the embodiment is described in the following text along with drawings, the function is to take out the differential output of square wave while the said clock pulse (Pc) is supplied for the switching operation of the transistor switch and also to limit the maximum voltage of the intergral wave form generated at the capacity load of the transistor below a certain level. When the input of the clock pulse (Pc) is suspended due to a trouble in the circuit of the said control unit 12 or in the power source 19, the transistor switch is turned to OFF, the integral voltage of the said capacity load goes up above a certain level, and the abnormal control signal (S_A) is supplied to the driving circuit 13. As mentioned before, to the driving circuit 13, locking or unlocking signal (Sl), (Su) is supplied by key input (Xn) when the control unit 12 is at normal condition and the solenoids 6A, 6B are driven by the ordinary power source 11. When the said clock pulse (Pc) is suspended, however, input (Sl)(Su) is not given, as a matter of course, and when the clasps 4A, 4B are locked, unlocking becomes impossible. At this abnormal condition, unlocking becomes possible by the signal (SA) input from the said detection circuit 111, but if the ordinary power source for the solenoid 11 is also in trouble by any chance, unlocking becomes

impossible. In the case of such a duplicated trouble, the external power source 28 (automobile battery as mentioned before for example) is connected to the external power source terminals 9A, 9B provided on the clasps 4A, 4B as shown by the dotted lines, then the solenoid unlocking voltage is realized by the diode 112 and the resistor 113 and unlocking by the solenoids 6A, 6B is made. Since the abnormal unlocking by the external power source 28 is effective only when the control circuit 12 is in trouble or the power source 19 is out or order, there is no need of particulary high confidential performance of the external power source terminals 9A, 9B.

Referring now to Fig. 9 and Fig. 10, the clock pulse suspension detection circuit 111 of Fig. 8 is described in the following text. The input of the clock pulse (Pc) is supplied to the input terminal 116 of the detection circuit 111 in the wave form as shown in Fig. 10 A. The voltage (V_1) is DC5V. The output voltage (V_2) of the resistor 117 is in the wave form as shown in Fig. 10 B. The output wave form of the differrential condenser 118 is as shown in Fig. 10 C, and the voltage (V_3) is about 0.6V. A diode 119 absorbs the negative output ($-V_3$) of the differential wave. A transistor switch 120 of emitter earthing NPN type, and when the differential output ($+V_3$) of Fig. 10 C is applied to the base 120B at the frequency(t_1) to (t_3), the emitter

current (I_D) is switched and charging and discharging of the capacity load of the condenser 121 connected to the collector 120C are repeated. . The resistor 122 in series with the power ource 11, which determins CR time constant together with the condenser 121. If the integral wave (V_4) as shown in Fig. 10 D is so composed to become 2.5V, discharging is made before the breakdown voltage 3V of the zener diode 123 is reached, the saw tooth wave-form as shown in Fig. 10 D is repeated, and the zener diode 123 keeps OFF condition. Because of this arrangement, no signal output is given to the output terminal 124 of the circuit 11 under normal condition of clock pulse (Pc) input. When the generation of the said clock pulse (Pc) is suspended due to a trouble in the circuit of the control circuit 12 or the power source 19, the transistor 120 is turned to OFF ($I_E = 0$), the charging voltage of the condenser 121 increases as shown by the dotted line in Fig. 10 D, and at the time point (t_5), the voltage (V_5) to turn on the zener diode 123, for example 3V, is reached. The transistors 125, 126 amplify the voltage (V_5) respectively, and both of them are turned on when the zener diode 123 turns on, to supply abnormal signal (S_A) to the said driving circuit 13 for unlocking operation of the solenoids 6A, 6B.

Described above are the composition and operation of an embodiment of the electronic locking device by the

present invention, and as a matter of course, the invention is not limited to the illustrations or descriptions nor to the suit case as described.

The followings are for an embodiment of the invention, a device that allows easy operation for abnormal unlocking yet has a high confidential performance to ensure the use with no worry, in which a proximity switch that is turned on by changing the magnetic field of the external power source circuit from outside in series is provided at a specific position so as to keep the high confidential performance at the unlocking operation by external power source in such abnormal coditions where the ordinary power source circuit is in trouble or the voltage drops.

Now back to Fig. 1, the lead switch 132 shown by the dotted line and held by an adequate retainer 131 at the left inside of the case is one of the key points of the present invention, that is conducted by a magnetic change from outside to turn on the circuit when a permanent magnet is put close to the switch, or to turn on the circuit when a ferromagnetic material such as an iron piece is put close to it. The former is called 2-pole type lead switch and is made of a glass tube of 3 - 5mm O.D. and about 20mm long of vacuum type or inactive gas sealed type in which a pair of lead wires made of a ferromagnetic material and treated by contact member at the top surface are placed facing each other, and the lead wires are drawn to close the circuit by

external magnetic field. The latter is a kind of micro-switch having a permanent magnet attached to the inside leads, which functions to close the circuit drawn by a ferromagnetic material such as an iron piece put close to it. These magnetic switches are easier to mount than other switches such as push-button switch or thermal or photo-electric switches, and the mounted position is not known from outside, accordingly, the unlocking operation can be more confidential. The terminals (MA) (MB) are either one of the above switches. Besides the primary function for locking and unlocking operated by the magnetic solenoid 6 shown by the dotted line below the clasps 4A, 4B of the suit case 1, they are so composed as the external power source connecting terminal for abnormal unlocking at a trouble in the power source system, which is one of the key points of the present invention. As the external power source, DC12V is taken out with lead wires from an automobile battery, in the same manner as described before for previous embodiment, and the positive (+) wire is inserted into the small hole 9A on the clasp 4A and the negative (-) wire into the small hole 9B on the clasp 4B. The positions of the small holes 9A, 9B are not limited to those illustrated, and as mentioned before, it is also possible to have the same effect simply by connecting the lead wires to the metal parts of the clasps without providing any small hole. This arrangement makes it

impossible for other persons who are not allowed to open the suit case to unlock the electronic locking device even when they come to know that the clasps 4A, 4B are the external power source terminals, unless they know that a magnet or an iron piece is required and also to which point on the suit case the magnet or the iron piece must be placed.

Referring now to Fig. 11, the circuit composition of the embodiment of the present invention is described as follows. A lead switch 132 is provided on the inner wall of the suit case and is turn on by a ferrite magnet 133 putting close to the case 1 from outside as shown by the arrow (a). If the switch 132 is a magnetic switch, the magnet 133 can be a piece of iron. The position of this switch 132 in the suit case is a kind of code known only by the owner of the suit case and this forms the code for abnormal unlocking in combination with the use of the magnet 133 or a piece of iron. The unlocking mechanism and operation by a specific person to open the suit case at an abnormal condition of the power source is as described above.

The following description is on the voltage judging circuit 22 of Fig. 11 and the power source switching circuit 23. In Fig. 12, the zener diode 56 is turned on at normal condition when the above mentioned output signals (Sl) (Su) are supplied from the control unit 12 to the base of the transistor 53 as the driving circuit

and yet the voltage of the power source 11 is above the specified level, i.e. DC5V, the transistor 54 is conducted, and a large emitter current (I_1) flows. Accordingly, the external voltage of DC12V is applied to the terminals 9A, 9B, base current does not flow through the base 55B of the transistor 55 hence the transistor 55 is turned off, and no current (I_2) flows. By this operation, the solenoid 6 is driven only by the signals (SL) (Su). This is the operation under normal condition. If the voltage of the power source 11 goes down below the specified level, 5V, the signal from the control unit 12 stops and the transistor 53 is turned off, and the zener diode 56 as well as the transistor 54 are also turned off at the same time making $I_1 = 0$. When the external power of DC12V is applied to the terminals 9A, 9B, the operation starts for abnormal unlocking by the solenoid 6.

Described below with illustrations is the device according to this invention provided with a simple abnormal unlocking code information process circuit that replaces only the unlocking function of the micro-computer under abnormal condition where the micro-computer fails to operate due to a trouble in the power source system or in the circuit.

Now back to Fig. 1, the proximity switch 142 retained by an adequate retainer 141 at right side of the suit case 1 is one of the key points of this invention,

which is the change-over switch to convert the normal solenoid driving power source, DC6V mercury battery, into the key button circuit when the control unit 12 goes out of order (including a trouble in the exclusive power source). This change-over switch is a lead switch of single-pole double-throw type or a proximity switch that incorporates a magnet to be operated by field alteration from outside of the suit case 1. When a magnet for the former case and an iron piece for the latter case is put close to the switch, the contact is switched (MC - MD) to (MC - ME) and the said power source connected to the contact (MC) is switched over to the common of the key button circuit. By this invention, however, the switching is not necessarily limited to the proximity switch 142. The invention also includes the circuit switching key (B) by a key button provided on the control board 3 for more simple operation although the confidential performance becomes somewhat lower.

Fig. 13 is the block diagram showing the circuit configuration of an electronic locking device by the present invention. One of the key point of this invention is the blocks enclosed by the alternate long and short dash line 21, and their signal systems. The abnormal unlocking judging circuit 143 as one of the essential factors of this invention. Memorized preliminary in the circuit is the code (Xa) for unlocking under abnormal

condition where the control unit 12 fails to operate due to consumption of the power source 19 or a trouble of any electronic part. It is then judged whether or not the number set by the key board 3, to which the signal voltage source as described below is applied, for key input agrees with the memorized number. Only when the two numbers are in agreement, the input to the input terminal 145 and the output to the output terminal 146 are made by the gate circuit 144. If the trouble of the control unit 12 is resulted while the suit case is locked, the magnet 133 or a piece of iron is put close to the proximity switch 142 then the movable contact (Mc) is switched to (ME), and the positive voltage (+V10) of the power source 11 is applied to the key board 3 and the gate circuit 144. When the positive voltage (+V10) is above the specified level, DC5 - 6V for example, the judging circuit 143 and the gate circuit 144 function normally. Accordingly, if the above mentioned unlocking code (Xa) is selected out of the number keys 10 and the number is pushed, the circuit 143 judges agreement, turns on the gate circuit 144 to apply the said positive voltage (+V10) to the solenoids 6A, 6B, and they are driven for unlocking. If the power source 11 is also dropped below the specified voltage level by any chance, no unlocking is made. Against such a duplicated trouble, the external power source ciruit 28 having the clasps 4A, 4B as the connection terminals

9A, 9B is provided, and the diode 112 and resistor 113 are provided in series with the positive terminal 9A. By this arrangement, the voltage of the external power source 28, for example 12V when an automobile battery is used, is adjusted to 5 - 6V of the power source 11. The key (B) in dotted circle on the key board 3 is the circuit switching key to take place the proximity switch 142, as mentioned before, to be pushed simultaneously when the said number key 10 is pushed.

Now follows the description on the composition and operation of an embodiment for the abnormal unlocking judging circuit 143 and the gate circuit 144 shown in Fig. 13 referring to Fig. 14. The signal source 12S supplied to the right side of the common line 3L of these keys is provided for the key input of the locking and unlocking code (Xn) at normal operation as shown in Fig. 13. Under abnormal condition, however, the signal source 12S is turned to OFF. The part enclosed by the dotted line 147 between the 10 pieces of the number keys 10 and the control unit 12 has the function of the judging circuit 143 and the gate circuit 144. Transistor inverters (I0 I9), which is so called signal inversion amplifier, generates the digital signal (L) of a low voltage, 0.2V for example, at the output terminal (b) when the digital signal (H) of a higher voltage than a threshold level (1.3V for example) is supplied to the input terminal (a). The lead wires at the output side

(L) are terminated at the terminal (C'), which is fixed to the insulation. The connection line 148 between the amplifier (OA) and the terminal (d) intersecting the lead wires (ℓ) at right angles is the code setting line and is electrically insulated from the above ten lead wires (ℓ) before setting.

The programing procedure for the memory of the abnormal unlocking code (Xa) by means of the inverter group (Io - I9) goes as follows. If the code is the 3-digit number of "248", the key circuits of ②, ④ and ⑧ are connected to the said line 148 with three short pins 149 as shown by black circles in the drawing. The connection is made by inserting the pins into the pin board. The output lead wires (ℓ) of the remaining inverters (⓪, ①, ③, ⑤, ⑥, ⑦ and ⑨) are also connected in the same manner to the short pins as shown by the marks (X). Because of this arrangment of short pins 149, the voltage (+V10) is applied at each point of the black circle when the keys (②, ④ and ⑧) are pushed at a time and the signal (H) is given. Since the other seven keys are not pushed, the output of the respective inverters (Io - I9) invert the input (L) as described above for output of the signal (H). While the ten inverters are connected in series by the lead 148, the output of AND circuit becomes the signal (H). Since the voltage (+V1) is applied to the power source terminals of respective inverters, though they are not illustrated, the said signal (H) is supplied to the amplifier (OA), the current

is amplified, and the solenoids 6A, 6B are operated. If any one of the number keys is pushed by a person who does not know the unlocking code, the inverter output of the circuit is turned to the signal (L), the output of AND circuit is then turned to the signal (L), the solenoids are not operated, thus the unlocking fails. The unlocking code (Xa) is memorized in this manner by the setting program of the short pins 149, and the gate is kept off unless the number keys of the circuits with black circles in Fig. 14 are pushed at a time. In other words, the simultanous pushing of the number keys generates the signal (SH) by the judging circuit 143 shown in Fig. 13. Since the short pin program can be changed freely at any time, the unlocking can be kept highly confidential. The code (Xa) is not limited to the above mentioned 3-digits and ordinarily 2 to 5 digits are used. Theoretically, one digit will do but it is not recommendable since the unlocking can be made if the ten keys are pushed one after another. Referring to Fig. 15, to improve the confidential performance further, provide more than one number of code line 148' to set the short pins 149 shown in Fig. 14 at random, compose the NAND circuit with 3-input AND circuit 150 and the inverter 151, and set the signal of agreement by the output.

Now follows the description of an embodiment of the device according to this invention so composed to be

unlocked by an external power source but not by key input irrespective of normal or abnormal condition of the power system or the control system.

Going back to Fig. 1 again, the small holes 9A, 9B are provided on the clasps 4A, 4B of the suit case 1 as the connection terminals holes to the external power source, and no proximity switches are provided in this embodiment. As the external power source, DC12V is taken out of an automobile battery with lead wires and the top ends are inserted into the holes, positive wire to the hole 9A and negative wire to the hole 9B. The positions of the small holes are not necessarily be as illustrated, and alligator clips may also be used on the top of the lead wires without providing the holes.

Fig. 16 is the block diagram to show the circuit composition of the embodiment by this invention. One of the key point of this invention is the external power source circuit connected to the terminal 6C of the solenoids 6A, 6B directly from the diode 112 which is connected in series with the positive external power source terminal 9A with lead wires 29, 30 from the external power source 28. By this composition, when no key input is made from the key control board 3 and either one of the locking or unlocking signal (Sℓ) or (Su) is not given from the control unit 12 to the driving circuit 13, it becomes possible to unlock by the solenoids 6A, 6B. In other words, the unlocking is made simply by the operation

to connect the external power source 28 to the external power source terminals 9A, 9B irrespective of the voltage of the ordinary power source 11, i.e. normal voltage above the specified level or abnormal voltage below the specified level, and also with no regard to the condition of the micro-computer control unit 12, i.e. normal or in trouble. The external power source terminal of this invention is not limited to the clasps 4A, 4B as shown in Fig. 1, and can be provided, of course, at any place of the suit case. The external power source 28 is not limited to automobile batteries either. It may also possible to provide the proximity switch 132 shown in Fig. 1 to this external power source circuit. The confidential performance of this embodiment may be somewhat lower. On the other hand, however, this has the advantages in that the structure and circuit are simple and rigid, and that the cost is lower. The compositions and operations of the embodiments according to this invention are as described above, and as a matter of course, this invention is not confined to the locking device for suit cases and is not limited to the illustrations or descriptions either.

Being composed as above described, this invention solves such problems that an electronic locking device becomes impossible to unlock due to the voltage drop or a trouble of the power source circuit of the solenoid or small motor for locking and unlocking while the device

is being locked, or the problems, though they do not happen very frequently, due to a trouble in the power source system and the circuit system of the micro-computer which contains a number of electronic parts. And, this invention offers a convenient device that can be used with confidence because it has the means to detect and judge any unusual condition in advance or immediately after it happens, the unlocking can be made simply and quickly with an automatic or redily available external power source, and because the abnormal unlocking operation can be kept highly confidential.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is oblique view of a suit case provided with an electronic locking device according to this invention;

Fig. 2 is the block diagram to show the circuit composition of the first embodiment of the invention;

Fig. 3 is a circuit diagram of the power source voltage judging circuit and of the power source switching circuit of the first embodiment;

Fig. 4 is the block diagram showing the circuit composition of the second embodiment of the invention;

Fig. 5 is a sectional side view to show the composition of the locking and unlocking control unit according to the invention;

Fig. 6 is an oblique view seen from the bottom of the above Fig. 5 to explain the automatic locking and locking preventive operations;

Fig. 7 is an embodiment circuit diagram of the electronic circuit of the invention;

Fig. 8 is the block diagram to show the circuit composition of the third embodiment of the invention;

Fig. 9 is an circuit diagram of the detection circuit that detect troubles of the micro-computer to generate abnormal control signal;

Fig. 10 A to Fig. 10 D are the drawings to show waveform at each part of the said detection circuit;

Fig. 11 is the block diagram to show the circuit compostion of an electronic locking device;

Fig. 12 is an circuit diagram of the judging circuit and of the switching circuit;

Fig. 13 is the block diagram to show the composition of an electronic locking device according to the invention;

Fig. 14 is an embodiment of the judging circuit for memorizing and comparison of abnormal unlocking code and for output of the agreement signal, and of the control circuit to drive the unlocking control terminal by the output;

Fig. 15 is the circuit diagram to explain another embodiment of the invention; and

Fig. 16 is the block diagram to show the circuit composition of an electronic locking device according to the invention.

3 ..... control board

4A,4B ..... clasps of suit case

5 ..... receptacle of multi-core connector

6A,6B ..... Solenoids

7 ..... Manual unlocking knob

8 ..... Hook

9A,9B ..... terminal holes

12 ..... Control unit of micro computer

132 ..... Proximity switch

142 ..... Proximity switch

MA,MB ..... Terminals

Mc ..... Common

MD ..... ON terminal

ME ..... OFF terminal

U ..... Unlocking key

11 ..... Power source

15 ..... power source

P1 P10 ..... 10 core socket connectors

S ..... Locking command signal

Su ..... Unlocking command signal

Sn ..... Judge signal

Sa ..... Judge signal

53,54,101,102,103,120,125,126 ..... Transistors

56,104,123 ..... Zener diodes

57,58,105,119 ..... Diodes

Xn ..... Code for key input

Pc ..... Clock pulse of square wave

12P ..... Clock pulse generating circuit

111 ..... Clock pulse stop detection circuit

T_D ..... Pulse width

Tp ..... Recurrence frequency

$\pm V3$ ..... Differential output of clock pulse wave

B ..... Abnormal switching key

12S ..... Normal key input signal source

SH ..... Agreement signal

133 ..... Magnet for proximity switch operation

+V10 ..... Abnormal unlocking signal and drive voltage

I0 ~ I9 ..... Semicondictor inverting amplifier

..... Output lead

148 ..... Code setting line

149 ..... Short pin for code programing

O_A ..... D.C. amplifier

H,L ..... Digital signal

6C ..... Common

WHAT IS CLAIMED IS:

1. An electronic locking device for locking and unlocking through control of an electric driver by key input of memory codes from outside for memory and relational computing process, characterized by comprising a circuit for judging that the voltage conducted from the normal power source incorporated in the said device to control the electric driver is at a level over the specified value or at a level below the specified value and for transmitting the signal, a circuit having the terminal for connection to the external power source to operate the said electric driver, and a circuit to switch the said electric driver to the said external power source circuit by means of the said discrimination signal.
2. An electronic locking device according to claim 1, in which the specified value for judging normal or abnormal voltage conducted from the ordinary power source is set at a constant value to renew the power source above the minimum driving level of the said electric driver, and the said electric driver being operated by applying the voltage of the said constant value conducted from the ordinary power source.
3. An electronic locking device according to claim 2, wherein a mechanism to prevent locking by key

input is provided when the voltage conducted from the ordinary power is lowered to the constant level for renewal.

4. An electronic locking device according to claim 1, in which a signal transmission circuit is provided to detect the suspension of the clock pulse generated as the normal timing control by the control unit for memory of the external key input and for coded information process by relational computation at consumption of the ordinary power source or at a circuit trouble, the electric driver being operated by the detection signal.

5. An electronic locking device according to claim 4, in which the circuit for detecting suspension of clock pulse and for transmitting the signal is composed of a differentiation circuit to take out differential output from the square wave of the clock pulse.

6. An electronic locking device for locking and unlocking through the control of an electric driver by key input of memory codes from outside for memory and relational computing process characterized by comprising a circuit for judging the voltage conducted from the normal power incorporated in the said device to control the electric driver is at a level over the specified

value or at an level below the specified value and to transmit the signal, the circuit having the terminal for connection to the external power source to operate the said electric driver and a proximity switch connected in series, the proximity switch being switched by the change in the external magnetic field, and a circuit for switching the said electric driver to the series circuit composed of the said external power source and the proximity switch by means of the said discrimination signal.

7. An electronic locking device for locking and unlocking through the control of an electric driver by key input of memory codes from outside for memory and relational computing process characterized by comrising the unlocking code information process circuit said circuit taking only unlocking function of the control unit for the processing of the said code information when the said control unit goes out of operation due to consumption of the normal power source or a trouble in the circuit.

8. An electronic locking device according to claim 7, in which the memory code for unlocking is set in two digits or more, the key input operation of the unlocking code information process circuit being made by pushing two or more keys on the ten key unit at a time.

9. An electronic locking device for locking or unlocking through control of an electric driver by key input of external memory codes for memory and relational computing process of code information characterized by comprising a circuit having the terminal to connect the external power source which drives the said electric driver from outside in parallel to the normal power source incorporated in the device to control the said electric driver.

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FIG. 1
第 1 図

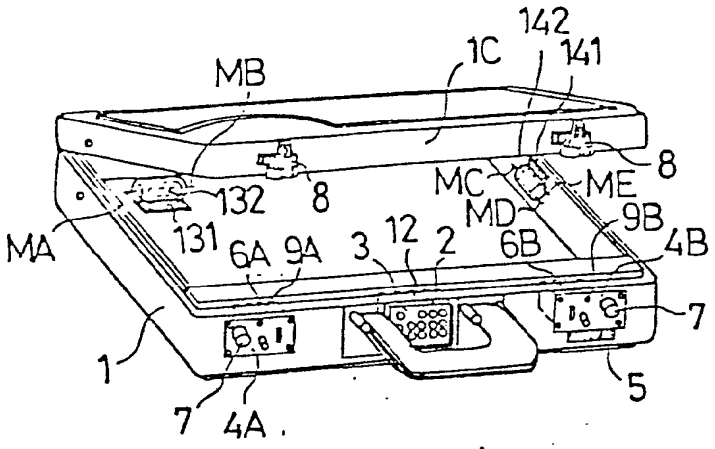

FIG. 2
第 2 図

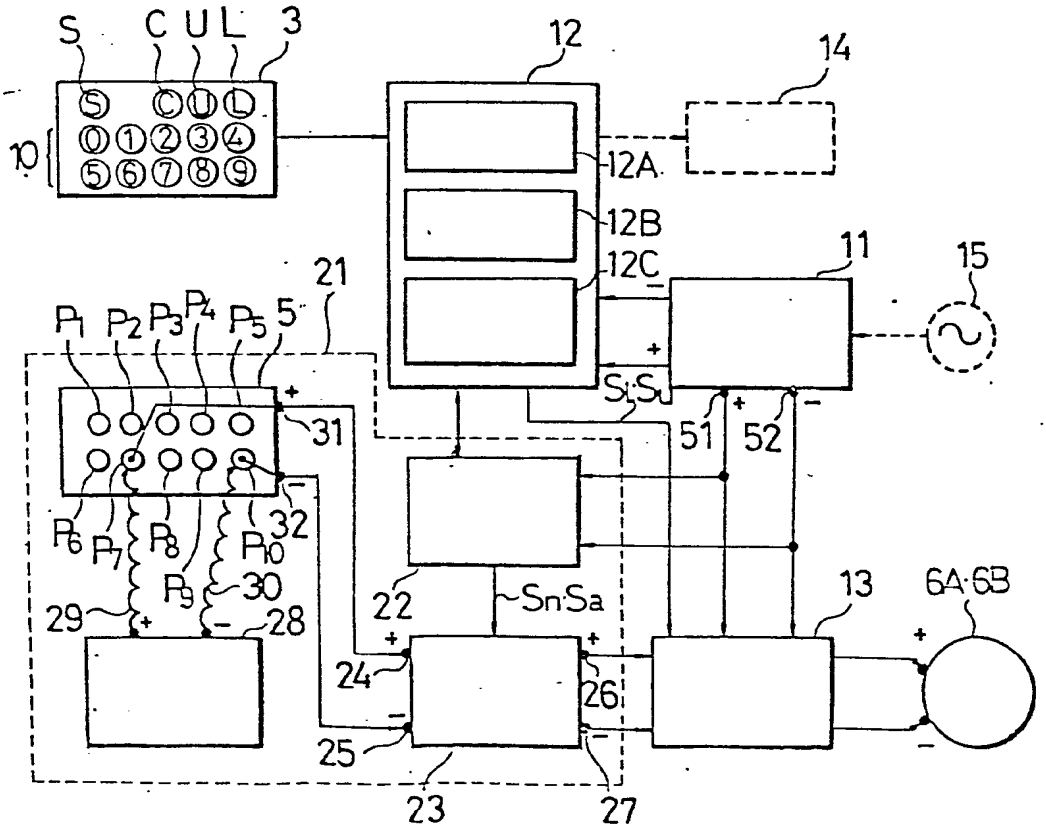

FIG. 3
第 3 図

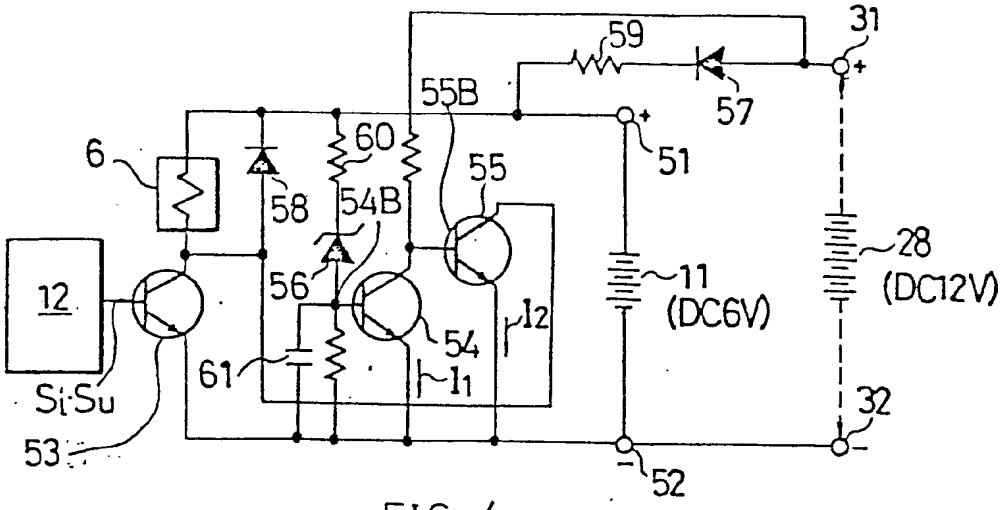

FIG. 4
第 4 図

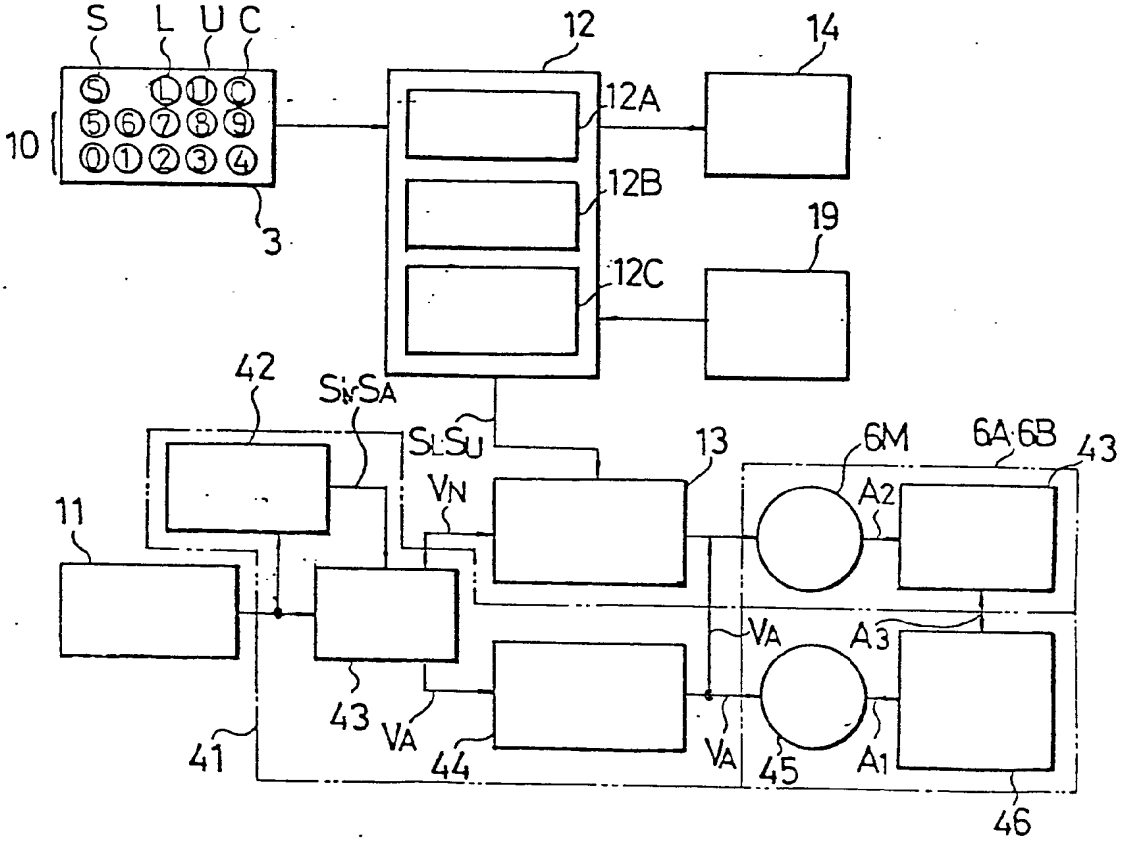

FIG. 5
第 5 図

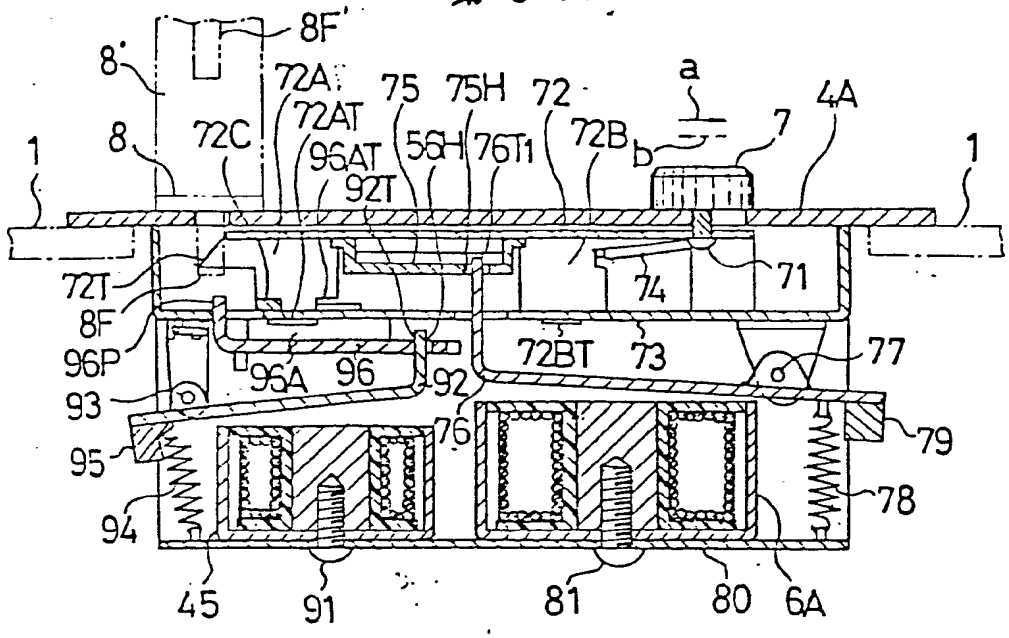

FIG. 6
第 6 図

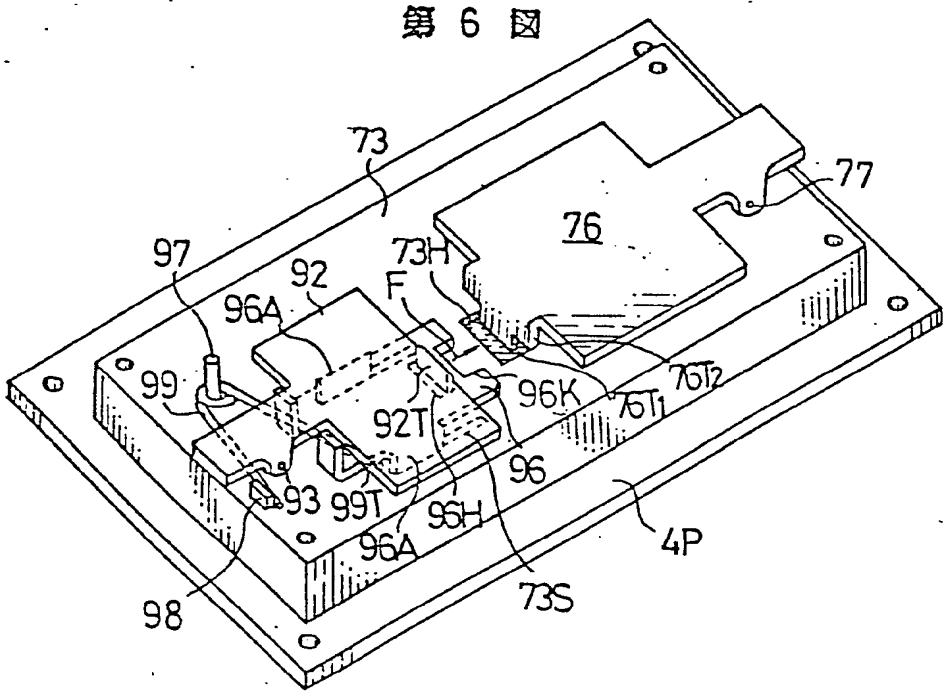

FIG. 7
第 7 図

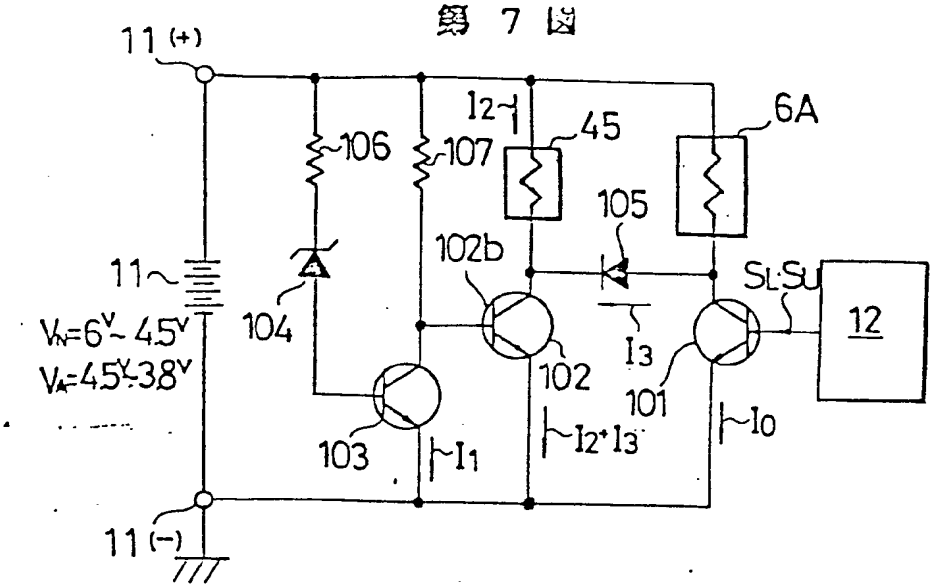

FIG. 8
第 8 図

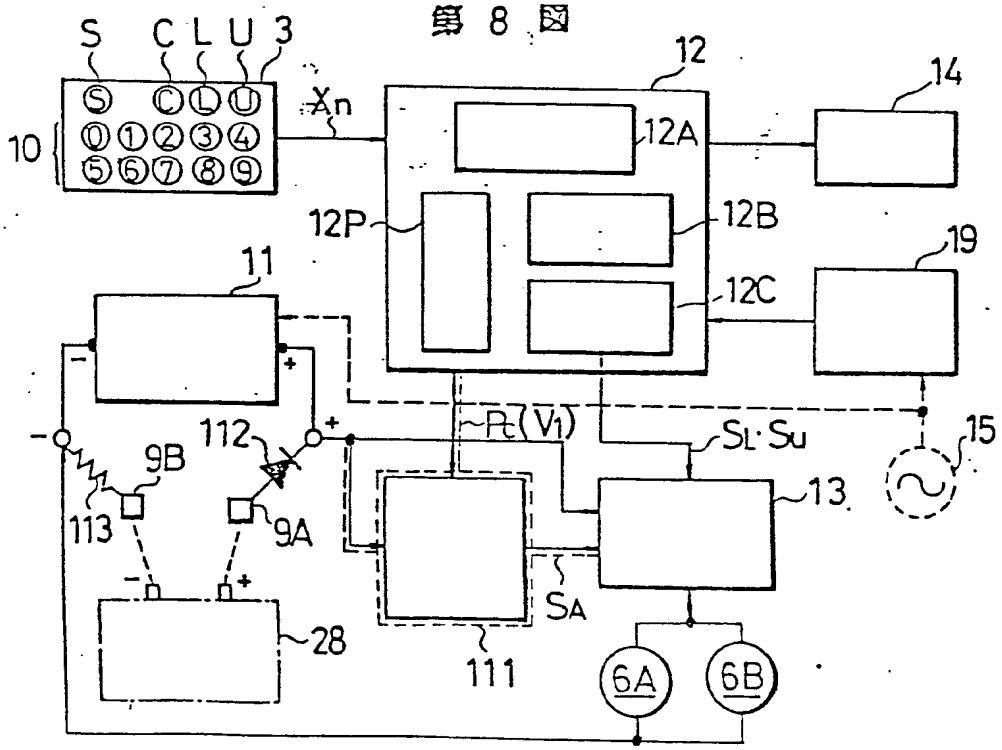

FIG. 9
第 9 図

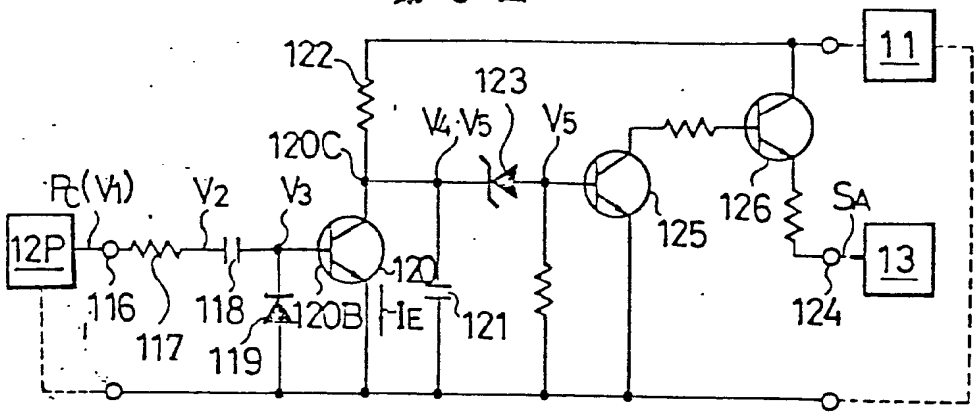

FIG. 10
第 10 図

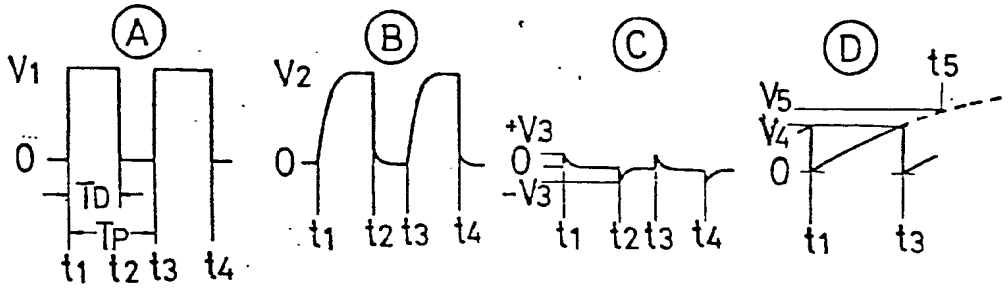

FIG. 11
第 11 図

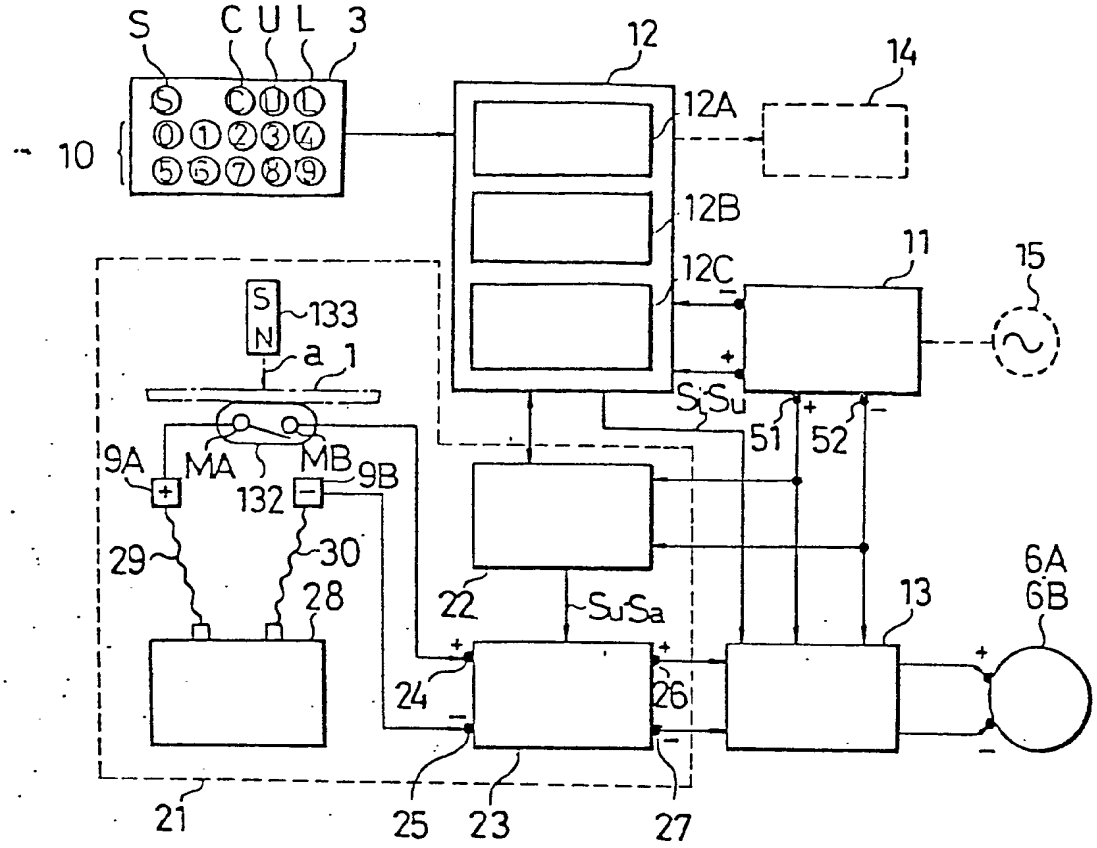

FIG. 12
第 12 図

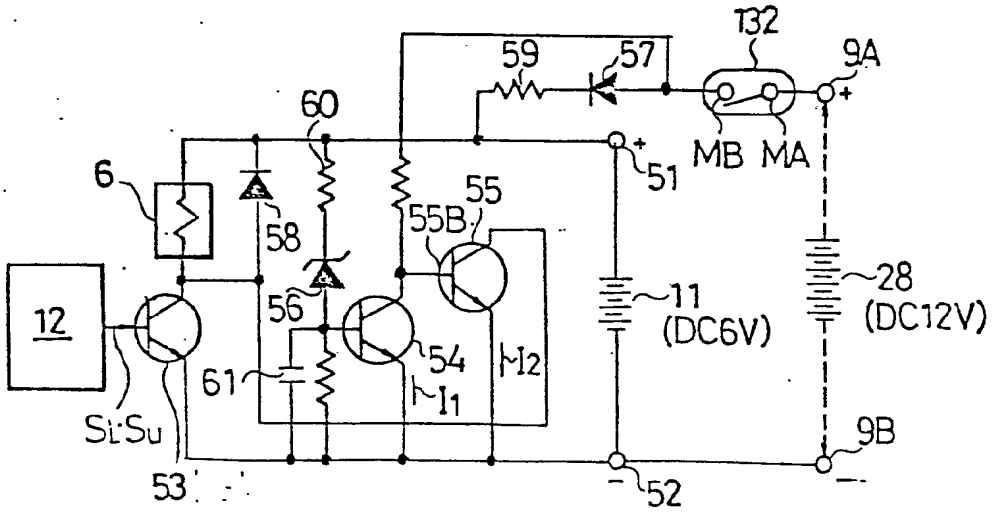

FIG. 13
第13図

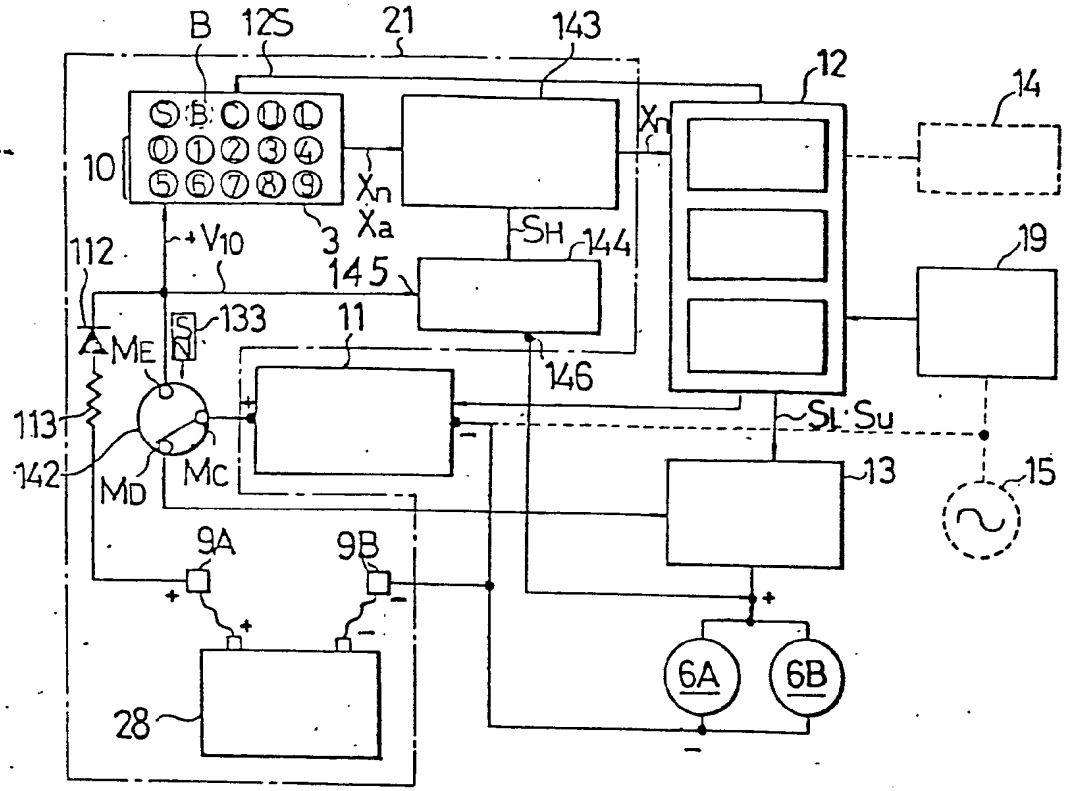

FIG. 14
第14図

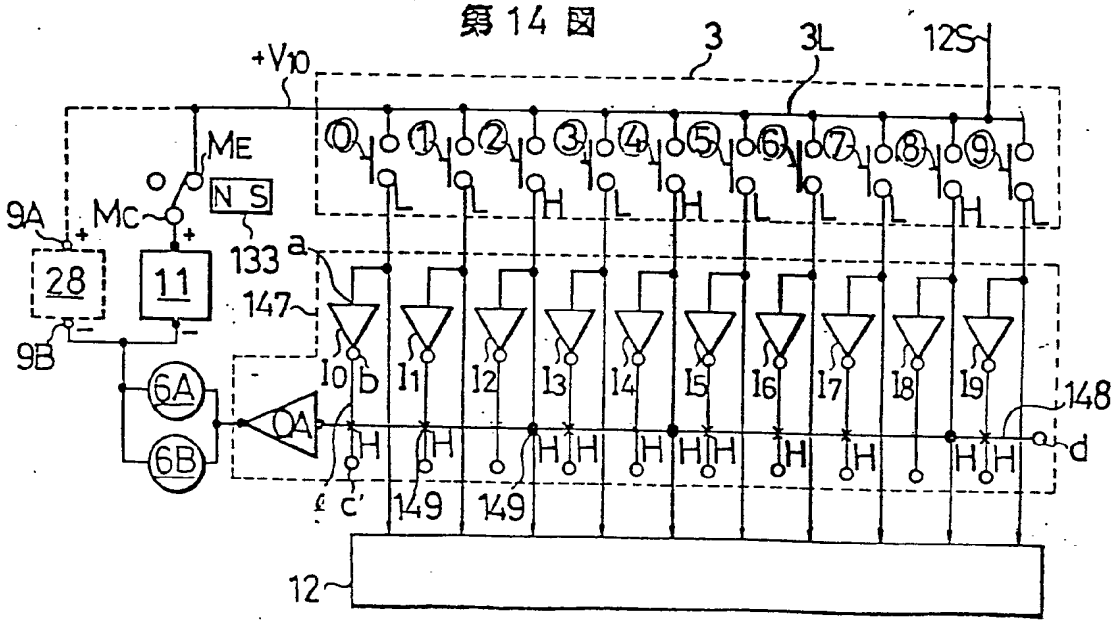

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FIG. 15
第15図

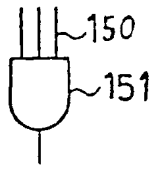
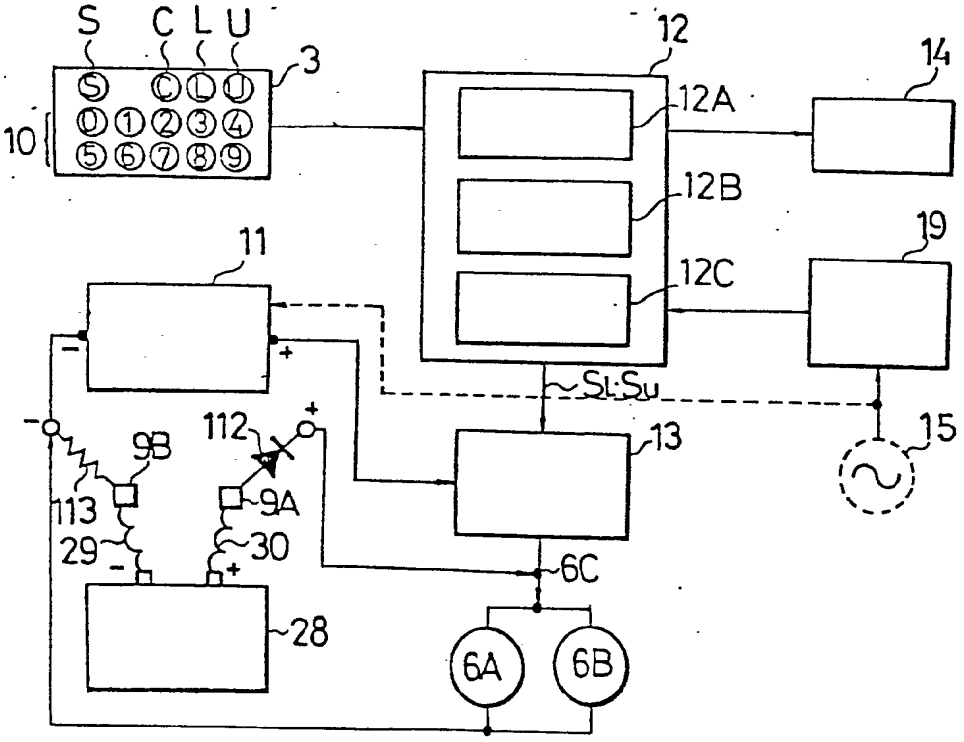


FIG. 16
第16図



European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 80 10 5643.3

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	RADIO AND ELECTRONICS CONSTRUCTOR, Vol. 29, No.2, September 1975 London C.K. SELLEN "Parallel S.C.R. combination lock" pages 78 to 81 * page 80, right column to page 81, paragraph 1 *	1
	DE - A1 - 2 548 889 (S.A. COMINIERE) * claim 16 *	1
	DE - A1 - 2 909 134 (NEIMAN GMBH + CO.) * page 7, paragraph 2 *	1
A	DE - B2 - 2 247 767 (SIEMENS AG) * claim 1 *	2
A	US - A - 3 663 867 (L. P. FISTER) * column 3, lines 21 to 46 *	1
A	US - A - 3 755 718 (N.H. NICHOLSON) * column 3, lines 10 to 20 *	1
A	US - A - 4 148 092 (R.MARTIN) * column 12, lines 22 to 31 *	1
A	GB - A - 1 414 120 (LEWIS SECURITY SYSTEMS LTD.) * page 2, lines 34 to 40 *	6

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

E 05 B 49/00

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

E 05 B 45/00
E 05 B 47/00
E 05 B 49/00
H 02 J 9/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
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E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

☒ The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	11-03-1981	WUNDERLICH

EPO Form 1503.1 06.78